



THE BOXWOOD LEAF MINER AND ITS CONTROL

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HABITS AND WORK OF THE BOXWOOD LEAF MINER

The boxwood leaf miner (*Monarthropalpus buxi* Lab.)¹ is usually observed as a small maggot between the upper and lower surfaces of an infested boxwood leaf. The presence and feeding work of the maggot generally produce a blister (fig. 1) on the leaf attacked, which may or may not become discolored. Under conditions of very heavy infestation there are several blisters on a leaf, and the entire leaf may become puffed or swollen. Usually the infested leaves contain several maggots and sometimes a great many (fig. 2). The maggots may be found in the leaves from the latter part of May of one year until early in April of the following year. Late in its life the maggot produces on the undersurface of the boxwood leaf a circular spot with a thin, almost transparent covering consisting only of the epidermis of the leaf (fig. 3, A). This is the "window" through which the insect escapes from the leaf. The maggot changes into a pupa (fig. 3, B) in April, and when fully developed the pupa breaks through the underside of the leaf, leaving the tail or abdominal end of the pupa within the leaf (fig. 3, C). When in this position the adult emerges from the pupa.

The adult leaf miner is a small, delicate, orange-colored fly (fig. 4). The fully developed pupa is also orange colored, but near the completion of the pupation period it has a distinctly blackish tinge at the head end of its body. The flies of the boxwood leaf miner usually begin to appear sometime between the 1st and 15th of May. The life of the individual fly is short, being only about 2 days. The insects continue to emerge from the leaves for a period of 2 weeks after their first appearance and are therefore found about the bushes during this time. The flies almost always hover closely over the

¹ Order Diptera, family Cecidomyiidae
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boxwood foliage, alighting on the new leaves now and then. The females lay their eggs by inserting them through the under surface of the leaves.

THREE CONTROL METHODS AVAILABLE

There are three methods that are successful in controlling the boxwood leaf miner. These methods are spraying, fumigation, and dipping or immersing the infested plants in hot water. The spray-

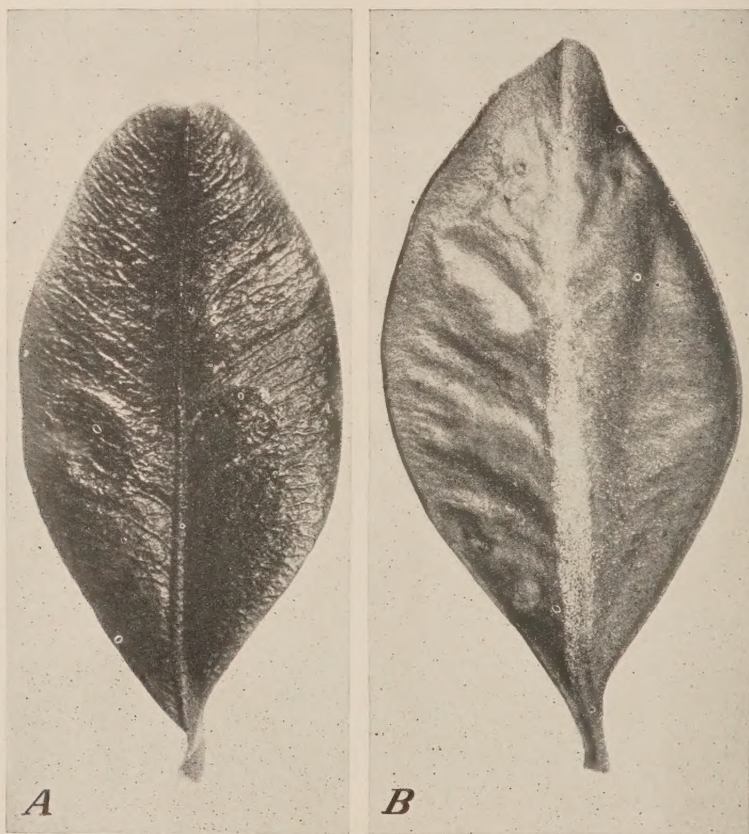


FIGURE 1.—Blisters produced by the boxwood leaf miner, shown on the upper surface (A) and the under surface (B) of boxwood leaves. $\times 4$.

ing method is the least expensive, requires the least equipment, and is the easiest to use, but it can be carried out only during one short period of the year and is effective only when carefully done. It is recommended particularly for owners of small or moderate quantities of boxwood and in communities where the boxwood of different owners is on adjoining property, because spraying really prevents new attacks and serves to protect uninfested boxwood as well as to clean up the infested plants.

The fumigation method is a very efficient means of control. Fumigation can be applied in the fall, winter, and early spring but requires proper equipment and certain favorable working conditions. The materials used for fumigation are highly poisonous and therefore should not be used by careless or ignorant persons.

The dipping method is also very efficient. Since the plants must be dug up so that they can be inverted and the tops immersed in the water, this method cannot be used readily in established plantings. The treatment will probably be most practical for the needs of the nurseryman who wishes to kill the leaf miners in plants before shipment, or before replanting them in a new, uninfested block.

CONTROL BY SPRAYING

The spray material is prepared by mixing the following:

Blackstrap or stock-	
food molasses -----	1 gallon.
Water -----	5 or 6 gal-
	lons.
Nicotine sulphate (40	
percent nicotine) --	8 to 10
<i>1500</i>	teaspoon-
	fuls.

The spray applications are effective only during the flight period of the flies. To determine the beginning of flight, the bushes will have to be watched rather closely, in the latter part of April and the early part of May, for the first appearance of the yellow-orange flies emerging from the pupae through the underside of the leaves. Commencing with the appearance of the flies, the leaves of the bushes (especially the underside of the leaves) should be kept sticky with the molasses spray for about 2 weeks, or until the flies have ceased to appear. Usually

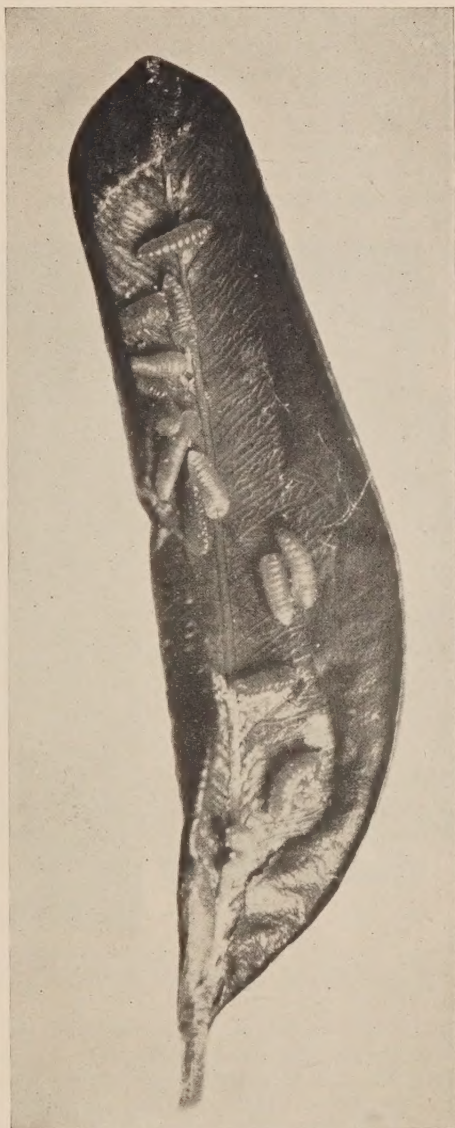


FIGURE 2.—Boxwood leaf miner maggots exposed by the removal of leaf tissue. $\times 7$.

3 or 4 sprayings, with an interval of from 3 to 4 days between one spraying and the next, are sufficient unless rainy weather intervenes. Muslin or some other rather lightweight cloth may be laid over the top of the boxwood after spraying, to prevent rain from washing off the sticky spray material.

To do the best work, a pair of angle spray nozzles on a Y-joint at the end of the spray rod should be used to produce a mist. The nozzles should be separated from each other by about 1 foot and in spraying they should be held rather close to the bushes. Proper coverage can be secured best by moving the spray nozzles over the boxwood with an upward sweeping motion, since this action puts as

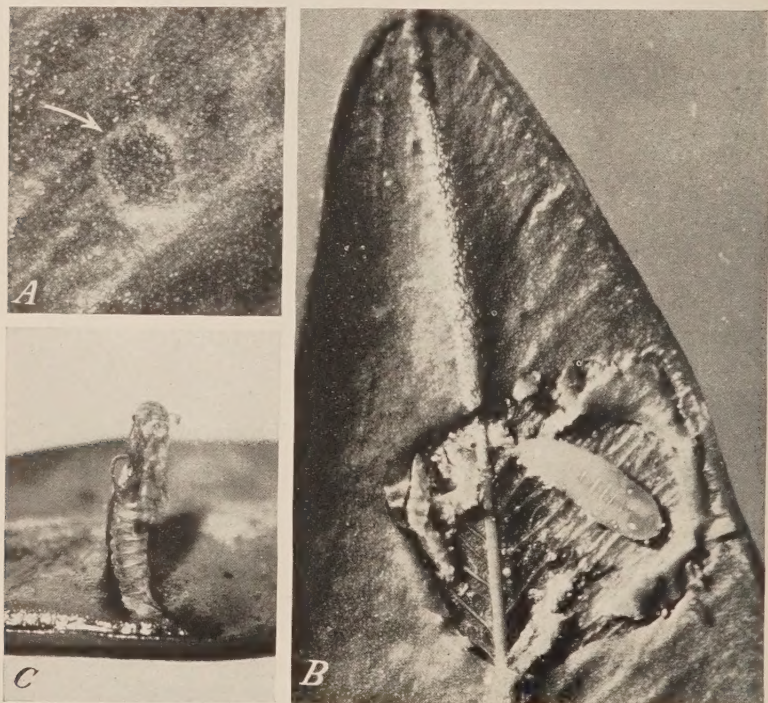


FIGURE 3.—A, the window through which the boxwood leaf miner emerges from the leaf, $\times 10$; B, pupa of the boxwood leaf miner, $\times 10$; C, the skin of a pupa protruding from a window and the boxwood leaf miner fly issuing from the pupal skin, $\times 10$.

much of the mixture as possible on the underside of the leaves. The spray provides a sticky covering to hold the flies that are issuing from the old infested leaves and those which return to the new foliage to lay eggs. The nicotine sulphate acts as a contact insecticide, rapidly killing the flies entangled by the sticky spray material.

After all of the flies have disappeared, it sometimes aids in the control of the miner if the bushes are clipped to remove as much of the new growth and the new leaves as practical. This control measure is especially valuable when the conditions have been favorable for the flies to lay eggs in the leaves, as, for example, when a rain during the flight period of the adults has prevented spraying or has washed off the spray previously applied. The presence of the

eggs of the leaf miner in new boxwood foliage can be determined shortly after the flight period of the flies by looking at the foliage while holding it between the eyes and strong sunlight. The places where eggs are laid show up as minute pale spots in the leaves. The appearance of a great number of these pale spots indicates the desirability of shearing off the affected new growth; however, severe clipping cannot be advised as a regular practice.

CONTROL BY FUMIGATION

For fumigation purposes a wooden frame is constructed to form an enclosure of 100 cubic feet, or multiples thereof. The 100-cubic foot size is very convenient and generally consists of four 2 by 2 inch uprights 5 feet high, 2 side pieces 1 inch by 6 inches on each side 5 feet long, and 2 end pieces 1 inch by 6 inches on each end 4 feet long. This frame is placed over the boxwood plant and covered with a canvas (fig. 5, A). For this particular size of frame, a piece of 12-ounce duck 16 by 18 feet, painted with linseed oil on both sides and allowed to dry afterward, works very satisfactorily. The canvas is placed over the frame, being folded over the corners, with the exception of the place where the dose is to be introduced, and the edges which touch the ground are covered with dirt to seal the flaps to the ground. The dosage for 100 cubic feet consists of 2 ounces, by weight, of sodium cyanide, 3 fluid ounces of sulphuric acid, and 6 fluid ounces of water. The technic of fumigation is as follows: The water is poured into



FIGURE 4.—The adult, or fly, of the boxwood leaf miner. $\times 12$.

a small earthenware crock or jar, or a glass beaker, and the acid is added slowly. This jar is placed inside the enclosure, with a piece of board or cardboard tilted over the top to prevent any spattering chemicals from getting on the bush or canvas. The canvas at the open corner is then arranged so that this corner can be rapidly closed. The cyanide, in a coarse paper bag, is then carefully dropped into the acid and water, the tent flap quickly folded over, and dirt placed on it. The fumigation lasts for 1 hour, after which the flap is pulled out quickly and carefully on one side and rapidly thrown back over the top of the tent to let the gas escape. The other sides of the tent should be rapidly thrown back on top of the tent 10 minutes after the first side is opened. When the gas has entirely escaped and the distinct peach-kernel odor has almost completely disappeared, the tent may be moved over to another bush. It is generally safe to move the tent after it has been ventilated with all

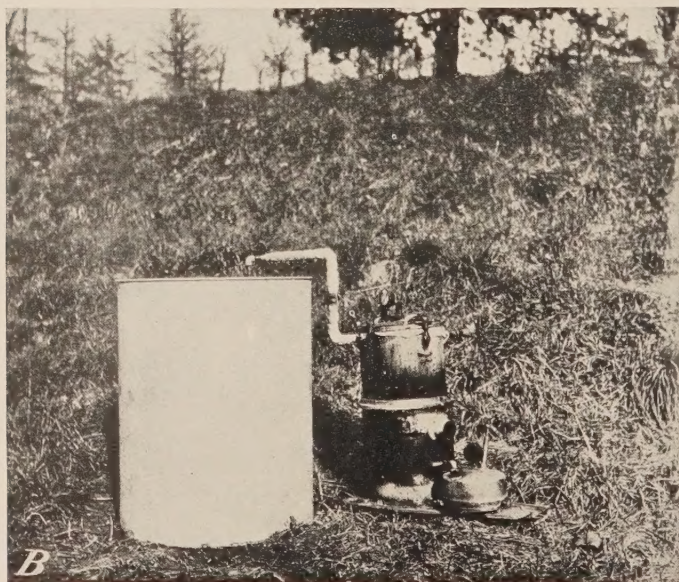


FIGURE 5.—A, two fumigation tents, the one on the right folded and with fumigation going on within; B, a small hot-water treatment outfit.

four sides open for 5 additional minutes. *Sodium cyanide is a very dangerous poison to handle, and the hydrocyanic acid gas generated in the tent is exceptionally deadly, so the operator must be careful not to inhale any of it.*

There are several precautions to be observed in fumigation which will prevent injury to the plants and insure the success of the work. One of these is to fumigate only dormant bushes; that is, bushes which are not sending out new growth. Another is to fumigate only bushes that are dry; that is, not wet with dew or rain. A third is not to fumigate when the temperature within the tents can exceed 75° F. This means, usually, an outdoor temperature not exceeding 60° in the shade when it is cloudy or 55° in the shade when the sky is clear. Fumigation is a *dangerous method*, although very successful, and should be performed by individuals familiar with cyanide fumigation or familiar with chemicals and the danger of this particular material, or by individuals who are particularly cautious and will be painstaking in following the foregoing directions.

Usually the best times of the year for controlling the boxwood leaf miner by fumigation are November, late February, and early March.

The death of the maggots in fumigated plants may be quite slow. Some larvae may be active and appear healthy for as long as a month after treatment, and some may even be living at the usual time for adult emergence in May, but the writers have never found leaf miner flies emerging from boxwood which had been carefully and thoroughly fumigated at the strength recommended.

CONTROL BY IMMERSION IN HOT WATER

The boxwood leaf miner can be killed by dipping infested plants into hot water. The temperature of the water and the length of the immersion period are both important in securing a kill of the maggots and avoiding injury to the plants. This method of treatment is especially suitable for nurseries but not very practical for established ornamental boxwood plantings. It requires digging up the plants to be treated in order to dip their foliage into the heated water. This treatment can be used by a nursery in the process of transplanting material, thus permitting the establishment of uninfested blocks, and it can also be applied to plants dug for selling or shipment.

The equipment necessary for this treatment consists of one or more tanks for immersing the plants in water and a steam supply either from a greenhouse boiler or from a special boiler² (fig. 5, B). The immersion tanks should be slightly deeper than the height of the plants to be dipped. In one case, barrels were used as treating tanks and in another instance a tank 3 feet deep, 4 feet wide, and 6 feet long was used. Hose or pipe connections for water and steam are run into the tank. Hand valves on the pipe connections should be provided near the tank so the operator can adjust the steam flow and regulate the temperature of the water, or, where practical, automatic water-temperature regulators to accomplish this purpose may

² If more permanent equipment for hot-water treatment is desired, the Bureau of Plant Quarantine, U.S. Department of Agriculture, can furnish excellent specifications.

be installed. An accurately calibrated Fahrenheit thermometer is suspended in the tank.

The method of treating is as follows: The water in the tank is maintained at a level of 1 or 2 inches below the top and is kept heated to the *required temperature of 120° F.* It is frequently stirred with a paddle to hold the temperature even in all parts of the tank. The temperature of the water should be read on the thermometer often, and as it falls or rises the rate of steam flow should be increased or decreased accordingly. The boxwood plants, after being dug, should have the soil ball wrapped in burlap to prevent the breaking of the ball and the dropping of soil into the tank. Extreme care should be taken in wrapping the ball in order to prevent the inclusion of any of the lower branches of the plant, which would then be protected from the hot water and thus permit larvae to escape the treatment. The plants are inverted over the tank and lowered into the water until the soil touches the surface of the water. Too many plants should not be immersed at one time; that is, the plants should be spaced so as to permit the free circulation of water through the foliage of each plant. Small plants are handled by hand. Larger plants are raised above the tank and then lowered into the water by means of rope and pulleys suspended from a scaffold. During treatment the soil balls are allowed to rest on the edge of the tank or on pieces of 2- by 4-inch lumber laid across the tank. After the plants have been immersed for the required time, they are removed from the water and are replanted in an area some distance from any source of infestation.

The leaf-miner larvae vary considerably in their resistance to heat, according to the season and their stage of growth. In experiments with water at 120° F. an immersion period of 10 minutes was required to kill the larvae in July, and 5 minutes during October and the spring treating period (March to mid-May). The plants treated in late summer and fall survived the following winter in good condition in most cases, and the spring-treated plants grew very well following treatment and transplanting. The plants treated early in the spring before the buds swell are uninjured, but the new growth present on plants treated later in the spring will be killed. However, new growth from adventitious buds is soon produced and rapidly replaces all indications of this injury.

The best time to use the hot-water treatment of plants seems to be in early spring before new growth starts. Later spring treatment, with its resulting temporary injury, is often to be preferred to fall treatment because of the hazard incurred in transplanting in the fall and the incomplete establishment of the plants before winter.

CONTROL A COMMUNITY PROBLEM

The control of the boxwood leaf miner is, to a considerable extent, a community problem. The insect tends to spread rapidly through all the boxwood of a vicinity where any infested boxwood exists, and therefore it is important for every boxwood owner in the entire neighborhood to cooperate in its control at least to the extent of applying careful treatment to his own boxwood.